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ABSTRACT

Research indicates that there are physical and social, and possibly cognitive, differences between left-handers and right-handers. The three substantive sections of this colloquium paper cover brain functions, theories pertaining to the genesis of handedness, and cognitive development as related to handedness. Section 1 provides a brief description of the brain and reviews the concept of left and right brain. Section 2, on the genesis of handedness, reviews theories on birth position, trait inheritance, cultural influence, birth stress, pathological factors, neurological anomalies, familial learning, and genetic determinants. Section 3 concludes that differences in cognitive abilities of left- and right-handers are very small and of little practical importance. Sections 4 and 5 provide charts of difficulties many left-handed people face in their daily lives, and a summary of the relationship between the various research findings and handedness. Section 6 provides a partial listing of famous left-handed people. Section 7 cites approximately 15 references. (RH)

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Implications of Being Left-Handed as Related to Being Right-Handed

by
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Implications of Being Left-Handed as Related to Being Right-Handed

Thesis: According to research, there appears to be differences between left-handers and right-handers. These differences, major or minor, are not only physical and social, but possibly cognitive as well.

I. Brain functions
   A. A brief description of the brain
   B. The concept of left brain and right brain
      1. Characteristics
      2. Relationship to handedness

II. Theories pertaining to the genesis of handedness
   A. Birth position
   B. Inherited
   C. Culture related
   D. Birth stress
   E. Pathological
   F. Neurological
   G. Familial
   H. Genetic

III. Cognitive development as related to handedness

IV. Difficulties many of the sinistral population face in their daily lives (chart)

V. A summary of the relationship between the various research findings and handedness (chart)

VI. Annotation (a partial listing of 'famous' people who were (or are) left-handed)

VII. Bibliography

Implications of Being Left-Handed as Related to Being Right-Handed

Introduction

The difference between right-handers and left-handers has puzzled man ever since he began to think about himself. But only now, through recent advances in brain research, have we begun to understand the relationship of handedness to the overall division of labor between the two hemispheres of the brain. Contrary to previous notions, left-handedness is not a mirror of right-handedness. Left-handers differ in at least two particular ways: they use their nonpreferred hand much more often and many have a different brain organization (Herron, 1976, p. 50).

Almost without exception, all human languages have built into them a polarity, a veer to the right. 'Right' is associated with legality, correct behavior, high moral principles, firmness and masculinity; 'left' with weakness, cowardice, diffuseness of purpose, evil, and femininity.

In English, for example, we have 'rights' as in 'the rights of man' and 'in his right mind' and even the 'Bill of Rights'. We have 'right' and 'left' in politics. In theology we have, 'At the right hand of God'. Even 'ambidextrous' means, ultimately, two right hands.

On the other side (literally), we have 'sinister' (almost exactly the Latin word for left), 'gauche' (precisely the French word for left), 'gawky', and 'left-handed compliment'. The Russian 'nalves' for left also means 'surreptitious'. The Italian 'mancino' for left signifies 'deceitful' (Sagan, 1978, pp. 183-184). Even the New Websters Dictionary (Patterson, ed., 1989 p. 131) defines left-handedness as follows: 'Using the left hand and arm with more dexterity than the right; sinister; insincere; awkward'.

Dr. Samuel Orton, former professor of Neurology at Columbia University, states that 'there exists no inconsiderable prejudice against left-handedness, which in many instances is so strong as to amount to the belief that the left is abnormal'. Dr. Orton declares: 'There is certainly no justification for this belief, and there is reason to believe that a high degree of specialization in either hemisphere makes for superiority, and that the good left-hander is not only not abnormal, but is apt to be better equipped that the indifferent right-hander' (Barsley, 1967, p. 173).

What proportion of the population is openly or originally sinistral? In the United States, Canada, Britain, Western Europe, among others, left-handed writing is permitted in schools. This handwriting is forbidden in Western and Eastern Germany, Greece, Sweden, in the Soviet Union, and in all countries behind the Iron Curtain. The rule is even more strict in Arab countries, probably the strictest of all. Africa, Asia, and India also adhere to the rule. Since this often applies only to actual handwriting and not to other activities, it is difficult to obtain information about the number of left-handed people there are (Barsley, 1967, p. 22).

There are many indications that the incidence of left-handedness has risen in the United States in the last few decades. Most authorities think that this is not because more people are being born left-handed, but because parents have become more permissive in allowing left-handers to remain left-handed. Thirty or forty years ago parents were told by psychologists that all sorts of nervous disorders, especially stammering, might result if a left-handed child was taught to use his right hand for

eating and writing. Not only would the changeover put a child in a state of emotional stress and rebellion, but (some authorities maintained) his brain would become confused as to which side was dominant, a confusion that would implicate the brain's speech centers. Today, the consensus among experts is that matters of handedness play an extremely minor role, if any, in stuttering and similar nervous disorders.

Most child psychologists advise that if a child is not strongly left-handed, no harm is done by gently and kindly inducing him, if possible, to switch to his right hand for eating and writing. If the child is strongly left-handed, however, it is best to allow him to remain so; not because compelling him to switch will make him a stammerer, but because it will emotionally upset him and probably be unsuccessful anyway. What effect such emotional stress may have on a left-hander, in the hand of over persistent parents, is a topic still being debated (Gardner, 1964, pp. 79-80).

Even with millions of switch overs, in the United States the actual left-handed population is about 35 million, roughly 15 percent of the population. On a worldwide basis, it is estimated that as many as 150 million to 200 million people have a predisposition towards being born left-handed (that's almost the total population of the United States) (Lindsay, 1980, pp. 3-4). One researcher, Dr. Bryng Bryngelson of the University of Minnesota, who has spent thirty years studying the problem, declared: 'If there were no interference on the part of parents, teachers, or social customs, 34 out of every 100 children born today would be left-handed and about 3 percent would be using hands with equal dexterity' (Barsley, 1967, p. 23).

Brain functions

The brain is composed of two hemispheres, left and right, which are connected by the corpus callosum. The corpus callosum, actually a bundle of nerve tissue, integrates the operations of the two hemispheres. It provides communication between them and allows the transmission of memory and learning.

On visual inspection, the hemispheres appear to be organized bilaterally symmetrical - that is, the right and left sides of the brain look like mirror images of each other. However, they also are organized asymmetrically, meaning there are structural and functional differences between them. Many specialized functions seem to be centered primarily in one hemisphere or the other. Although the language area is in the left hemisphere for the majority of people, it can develop in either hemisphere (Vitale, 1985, pp. 3-4).

Each hemisphere of the brain specializes in separate and unique ways of processing stimuli. In short, the right brain and the left brain have specialized thinking characteristics. They do not approach life in the same way, yet both hemispheres use high-level cognitive modes.

The left hemisphere approach to life is part-to-whole. It sequences and is logical. The right hemisphere learns whole-to-part. It does not sequence; it looks at things holistically in an over-all picture.

Linear means part-to-whole. The left-brained person takes little pieces, lines them up, arranges them in logical order, and arrives at a convergent conclusion. The right-brained person thinks whole-to-part, holistically. The child with a dominant right hemisphere starts with the answer, a total concept, or perceives the whole pattern and discovers a

divergent conclusion. Very often he experiences difficulty with sequential thought (Vitale, 1985, p. 11).

The left brain is most responsible for linear, sequential, analytic, and rational thinking. Reading, language, the computational aspects of mathematics, the inquirer, and the critic are located in this hemisphere. Thoughts of a metaphoric, spatial, holistic nature is the province of the right hemisphere. Here we find involvement with the creation of art, music, the concepts of mathematics, synthesizing, intuitive knowing, and a more coherent perceptual style. The right brain seems better at passive comprehension, the left at active articulation. Some ways of differentiating functions of the left and right brain that have been suggested follow (Clark, 1983, p. 24):

left	right
math, history, language	self, elaborates and increases variables, inventive
verbal, limits sensory input	nonverbal, perception and expressive
sequential, measurable	spatial
analytic	intuitive
comparative	holistic
relational	nonreferential
referential	integrative
linear	Gestalt
logical	imagery
digital	depth perception, facial recognition
scientific, technological	mystical, humanistic

Rigidity of specialization should not be overemphasized. There generally is a balance between the hemispheres, with each taking control of the tasks it is best at handling (Vitale, 1985, p. 9). In studies that have been completed concerning the two brain hemispheres, the majority of the time the two hemispheres which are thought to have unequal abilities in a given situation, the superior hemisphere should assume responsibility

for responding. More recent work, however, has suggested that this is not always the case and that the hemispheres can differ in their disposition to respond at particular times. Jerre Levy and Colwyn Trevarthen conducted a study where the brain hemisphere deviated from the expected pattern. The results from their study showed that a given hemisphere does not always do the tasks for which it is thought superior, nor in performing a task does it always process information in the manner expected of it. This surprising result led Levy to speculate that 'hemispheric activation' does not depend on a hemisphere's real aptitude or even on its actual processing strategy on a given occasion, but rather on what it thinks it can do (Springer and Deutsch, 1981, pp. 51-52).

There is, according to many researchers, no direct connection between the hand you prefer to use for most tasks and the cerebral hemisphere that controls speech. The majority of left-handers may have speech centers in the left hemisphere as opposed to being in the right hemisphere, although this point is in dispute (Fadely and Hosler, 1979, p. 65; Sagan, 1978, p. 188). Nevertheless, the existence of handedness itself is thought to be connected with brain lateralization. Approximately 97 percent of all right-handed adults are thought to be left-hemisphere dominant for speech. Only 60 percent of left-handed adults are right-hemisphere dominant for speech. Moreover, both left-handed and ambidextrous persons tend toward having speech representation in both cerebral hemispheres. Although these correlations suggest a relation between cerebral dominance for speech and handedness, their imperfect association, particularly in non-right-handers, leaves many questions concerning the relation unanswered (LeDoux, 1984, p. 239).

There are cases of children though right-handed appear to be controlled with the right hemisphere organization; or left-handed controlled with the left hemisphere organization. A left-hander may evidence left hemispheric dominance, but have adequate capacities in the right hemisphere, also. In essence, many left-handed children and adults do not demonstrate deficits in either language or spatial-creative functions. It is the relationship which is important and which hemisphere is actually dominant. But the simple notion of handedness as related to the dominant hemisphere is too simple to understand (Fadely and Hosler, 1979, pp. 64-67).

The left and right processes must work together to bring forth ideas and execute them successfully. All of us use both hemispheres but we may use one side more than the other. When speaking of right-brained or left-brained, it simply means that one hemisphere is used to a greater extent than the other (Vitale, 1985, p. 9). In her book, Teaching for the Two-Sided Mind, Linda Williams (1987, p. 7) says that hemispheric research indicates each side of the brain performs a complimentary type of processing. She emphasizes, 'One form is not superior to the other; effective thinking requires both'.

Theories pertaining to the genesis of handedness

The fundamental question of whether handedness is essentially biological or cultural goes back to at least Plato and Aristotle. Plato attributed right handedness to 'the folly of nurses and mothers' while Aristotle believed that it was fundamentally organic (Corballis and Beale, 1984, p. 98).

Throughout the generations there have been various theories concerning the genesis of handedness. Some have been more prevalent than others. However, the current consensus among many researchers is that handedness is basically genetic in origin, though a number of researchers still question the issue.

The following are some of the theories that have been researched:

Birth Position

A. J. Comte suggested that those born with heads to the left and were twisted to the left in the uterus were the left handers. The reverse argument applied to those heads that were twisted to the right. However, it was later thought that there was no correlation between birth position and handedness (Corballis and Beale, 1984, p. 101).

Inherited

Whether one believes that variations in handedness are due to environmental or genetic variations, there is no disputing that handedness is inherited, at least to a degree. That is, a person is more likely to be left handed if one or the other parent is left handed and more likely still if both parents are left handed (Corballis and Beale, 1984, p. 112).

Roughly 90 percent of all living humans are believed to be right-handed. Since this has been so for a long time, the trait may be inherited (LeDoux, 1984, p. 239).

Culture Related

The strong cultural bias toward right-handedness is thought to force many natural left-handers to use their right hand (LeDoux, 1984, p. 239).

While patterns of hand preference at an individual level may be more subject to genetic determination than to intra-familial learning,

population studies of handedness indicate that the influence of culture is not negligible. Shannon (1979) argued that left-handers are less resistant than right-handers to cultural pressure. It is possible that there has been a relaxation of cultural pressure to use the right hand over the last few decades. An increase in dextral preference with increasing age has been reported among normal (e.g. Annett, 1973, 1979; Carter-Saltzman, 1980) and psychiatric subjects (Fleminger, Dalton, and Standage, 1977). Levy (1976) calculates that the frequency of left handed writing in the United States has risen from 2.2 percent in 1932 to over 11 percent in 1972, which she regards as the asymptotic frequency of sinistrality in the absence of cultural pressure to use the right hand (Beaton, 1985, p. 32).

Even those who argue in favor of genetic determination of handedness are willing to acknowledge that the degree and/or direction of hand preference can be modified through learning. Such learning may be mediated through the culture in which an individual lives and/or through his immediate family environment. The fact that cross-cultural differences in the distribution of handedness has been observed (Silverberg, Obler, and Gordon, 1979) suggest a sociocultural influence, although cross-cultural differences in the gene pool logically can not be ruled out (Beaton, 1985, p. 30).

Birth Stress

Paul Bakan of Simon Fraser University has proposed that left handedness may be the result of lack of oxygen at birth. He suggests that the tendency to birth stress may itself be inherited, although he points out that some 85 percent of left handers have two right-handed parents.

He also points out that left handedness is more frequent among males than among females, among twins than among the singly born, and among first borns, all supposedly prone to the higher incidence of birth stress. Bakan points out than in most cases the effects of lack of oxygen at birth are transitory, and he suggests that handedness may be affected without any other adverse complications. Follow up studies failed to reveal any clear relation between birth complications and subsequent handedness (Corballis and Beale, 1984, p. 115).

Birth stress complications might be expected to be more frequent in socially disadvantaged mothers and thus any association between birth stress and handedness would be more likely to be revealed in families whose socio-economic status is relatively low. (There is, of course, the complicating possibility that families differing in socio-economic status also differ in their tolerance of 'deviant' hand usage). However, Leiber and Axelrod (1981) found no difference in non-dextrality among student respondents as a function of the occupational (or educational) level of their parents but the incidence of low occupational status groups in this study was very low, which may have contributed to the negative finding. Interestingly, in the Leiber and Axelrod study, among the parents of the respondents, the proportion of left handedness was significantly higher among fathers (and in the same direction but not significant for mothers) whose occupational or educational level was high compared with fathers of low occupational or educational level. This might be explained by assuming that high-status fathers came from families who, two generations ago, were more tolerant than low-status families of transgressions of the cultural norm. In the more relaxed attitude of today, there may

be no difference between families of high and low status (Beaton, 1983, p. 18).

Pathological

A higher than expected incidence of left handedness has been reported for a wide variety of different clinical populations including stutterers (Hecaen and Ajureaguerra, 1964), autistics (Colley and Parkinson, 1977), epileptics (Silva and Satz, 1979), and the mentally retarded (Hicks and Barton, 1975). This may have helped to promote the idea that left handedness, per se, is abnormal and may explain the suspicion that has attended the left (sinister) hand since Biblical times.

A raised incidence of sinistrality among diverse clinical groups can be explained by assuming that in the case of very early brain damage lesions affecting only one side of the brain induce a shift from pre-determined handedness. If unilateral lesions affect left and right hemispheres with equal probability, then, given that most people are initially destined to become dextral, a larger number of pre-determined right-handers will become 'shifted' sinistrals than pre-determined left-handers will become 'shifted' dextrals. Thus, the population of normal left handers becomes inflated to a proportionally greater extent (Satz, 1972)(Beaton, 1985, p. 19).

Paul Satz believes that pathological factors can account for a good deal of the elevated increase of left-handedness among certain clinical populations as well as some of the left-handedness in the population at large. The remaining left-handers are, in his view, 'natural' left-handers whose left handedness is genetic in origin (Springer and Deutsch, 1981, p. 111).

Neurological

The left-handed world should not be considered an accident of nature but a neurological choice which is dependent on both genetic or prenatal conditions and on the cultural environment. Handedness develops along with the maturation of the nervous system and particularly with the growth of myelin, an insulating matter, in the corpus callosum. Together with handedness, the myelination of the corpus callosum coincides with the learning of precisely controlled body movements and basic cognitive processes (Herron, 1976, p. 53).

Controlled studies have supported the curious observation that infants show an initial preference for the hand opposite the one they ultimately prefer. Arnold Gesell and Louis B. Ames conducted research that showed frequent shifts between left handedness, bilaterality, and right handedness during the first year of life. The inital dominance of the left hand gave way after the first year to an increasing dominance of the right hand among the majority of children.

Since right handedness emerges only gradually over the first year of life, it might at first seem reasonable to suppose that it is acquired by learning or imitation. However, it is not clear how this would explain the early left preference for the left hand. Gesell and Ames themselves argued against such an interpretation. They were struck by the orderly way in which hand preferences fluctuate. Children of a given age were remarkably consistent in their preferences, especially at the younger ages. Gesell and Ames concluded that 'handedness is a product of growth'. In other words, it is programmed into the nervous system and

unfolds as part of the process of physical maturation rather than as a response to environmentally or culturally imposed biases.

A further reason for supposing that handedness is a product of maturation rather than learning is that children exhibit a striking postural asymmetry both before and shortly after birth, and this seems to be related to subsequent handedness. This asymmetry is the so-called tonic neck reflex, in which the head is turned to one side, the arm and leg on that side are extended, and the opposite arm and leg are flexed. Most children display a right tonic neck reflex, which is to say that they turn their heads to the right. From the data collected on the important aspect concerning tonic neck reflex, it is strongly predicted that right tonic neck reflex predicts right handedness and left tonic neck reflex predicts left handedness (Corballis and Beale, 1984, pp. 102-103).

The hemispheres of the brain demonstrate tremendous ability and flexibility and regardless of a natural tendency toward one mode of organization or the other, it is possible for either hemisphere to assume dominance in hand preference. The left-handed or 'right-minded' individual is organized in as efficient a manner as is the right-handed or 'left-minded' individual. The task for the left-handed child is to adapt his organization into a world that is dominated by individuals with the opposite mode of organization. The left-handed, right to left organization, is as natural and appropriate neurologically as is the cultural norm structure of left to right. The left-handed individual is simply different from the norm. How long it takes the child to learn this 'neurological switch' will depend on general language and intellectual capabilities, and on the amount of experience he gains (Fadely and Hosler, 1979, p. 52-53).

Familial

The role of familial learning was examined by Leiber and Axelrod (1981). It was hypothesized that having sinistral first degree relatives would influence the direction and/or degree of hand preference expressed by the respondents. The data did indeed show an increased incidence of sinistral preference among individuals with left handed relatives, the incidence being higher with a sinistral parent compared with sinister siblings and slightly greater when the mother as compared with the father was left handed. With regard to degree of consistency of hand preference, the prediction was upheld for right handers in so far as there was a small shift away from full dextrality in individuals with sinistral relatives. For left handers, however, having sinistral relatives was associated with a decrease in degree of left handedness. This apparently paradoxical finding was attributed by Leiber and Axelrod to the fact that people calling themselves left handed are less consistent in their use of the left hand than are self classified right-handers with respect to the right hand. Consequently, in families with left-handers, there is a less consistent model to follow and this might increase the variability of hand preference among respondents. However, McKeever and van Deventer (1977) found no significant influence of familial sinistrality on degree of left or right handedness.

The inference which Leiber and Axelrod drew from their findings was that intra-familial learning plays only a very minor part in influencing manual asymmetry. They concluded that there are 'definite limits set . . . by biological determinants to the influence which training can exert on human handedness'. They do not, however, explain the increased incidence

of left handedness in respondents with sinistral relatives. They presumably regard this as reflecting an inherited, rather than learned tendency for left handedness to run in families. Clearly, an equally strong case could be advanced for the contrary argument. A compromise is suggested by the finding that the incidence of sinistrality among respondents is greater with a left-handed mother compared with a left-handed father, which might reflect a sex-linked biological determinant, whereas the presence of a sinistral father was associated with an increased degree of left handedness in sinistral respondents and decreased dextrality in right-handed respondents. This effect of paternal sinistrality might relect the influence of early learning (Beaton, 1985, pp. 30-31).

Left-handedness is not a unitary unit. As several studies suggest (Bryden, 1973; Hecaen and Sauget, 1971; Hines and Satz, 1971; McKeever, 1973; Zurif and Bryden, 1969), the left-handed with a positive family history of left handedness are different in many ways from the left-handed who are solitary within a family of right-handed. These left-handed with no family history are, paradoxically, the most strongly left-handed and most often show a pattern of cerebral localization that is characteristic of the right-handed (Hardyck and Petrinovich, 1977, p. 385).

Many researchers believe that the issue of whether handedness is determined primarily by intra-familial learning or is largely inherited can only be decided by adoption studies. Hicks and Kinsbourne (1976) found in a partial cross-fostering study that the hand preference of their student respondents was associated significantly with the writing hand of their biological parents but not with that of the step-parents. That was

the case because most of the respondents were old enough for hand preference to have become firmly established (Palmer, 1964) before they acquired a step-parent. Thus the results reported by Kinsbourne and Hicks are not surprising.

Another study, by Carter-Saltzman (1980), compared handedness distributions in the children of biological and adoptive parents (of babies before their first birthday) as a function of parental handedness. Her results indicated that handedness is determined more by biological factors than by upbringing (Beaton, 1985, p. 31).

The evidence pointing to differences in brain organization between persons with and without a family history of left handedness has been taken by some to be a sign of a genetic component to handedness. The same relationship, however, may also be viewed as a support for an environmental determinant of handedness (Springer and Deutsch, 1981, p. 115).

Genetics

Early genetic theories dealt with handedness in isolation from the problem of hemispheric representation of speech (e.g. Chamberlain, 1928; Rife 1940; Trankell, 1955). Yet the fact that cerebral dominance is related to handedness, albeit imperfectly, implies that both manual and cerebral asymmetry should be considered together. Two recent genetic theories which attempt to do so are those of Levy and Nagylaki (1972) and Annett (1972, 1975, 1978). It should be borne in mind, however, that theories championing the influence of genes in the determination of handedness do not thereby exclude the possible influence of environmental factors on the final expression of hand preference (Beaton, 1985, p. 21).

Is handedness, like eye color, blood type, and general body build, genetically determined? The probability of two right handed parents of having a left-handed child is 0.02. It rises to 0.17 if one parent is left-handed, and to 0.46 if both are left-handed. Fifty-four percent of the offspring of two left-handed parents are right-handed.

Two left-handed parents could provide a child with different experiences relevant to the determination of handedness just as they might provide specific genes. Nature (genes) and nurture (experience) are confounded in these figures, making it impossible to sort out the contribution of each.

One way to approach this problem is to formulate specific models of how handedness might be transmitted from generation to generation through the action of genes. There are several models presently used by researchers (e.g. Levy and Nagylaki, Annett). However, these models are less than totally satisfactory in attempting to prove that handedness is completely based on genetics (Springer and Deutsch, 1981, pp. 106-108).

The simplest kind of genetic theory would be one in which handedness is controlled by a single gene. But this is not plausible because there are children born to left-handed parents who are themselves right-handed and right-handed parents who have left-handed children, or even mixed handedness parents having right or left-handed children. The difficulty with genetic theories is not so much that they are demonstrably false, but rather that they tend to be arbitrary. It is easy enough to invent reasons why the observed facts do not fit a theory, but in doing so one tends to lower the credibility of the theory. More generally, there appears to be no precedent anywhere in biology for the idea that the

direction of an asymmetry can be genetically coded (Corballis and Beale, 1984, p. 117).

One theory that supports the genetic theory of handedness was developed by Marian Annett (Corballis and Beale, 1984, p. 126). Though many researchers do not believe that the genetic theory is plausible, this one is more acceptable and convincing because it is broadly consistent with what is known about genetic influences over other biological asymmetries. It incorporates a component due to environmental and pathological influences. These influences, moreover, account for the fact that handedness varies in continuous fashion, despite the two basic genetic categories implied by the theory.

The evidence from Annett's theory suggests that familial left-handers show no overall bias in cerebral lateralization. Indeed, individuals in this category often have language skills represented on both sides of the brain. Nonfamilial left-handers, on the contrary, seem to show the normal left-cerebral dominance for speech (Corballis and Beale, 1984, pp. 126-138).

Arguments which support a genetic influence on handedness have been summarized by Levy (1976) and include the following:

1.) A number of functional and behavioral asymmetries present at or around birth, and hence not explicable in terms of learning, have been found to correlate with handedness.

2.) Handedness has been related to anatomical asymmetries of the brain (Sutton, 1963) and rose to dermatoglyphic (fingerprint) patterns (Rife, 1940). It would be surprising if these asymmetries were under genetic control and yet handedness was not so influenced.

3.) Familial studies of handedness suggest a genetic factor (Rife, 1940; Annett, 1973): in particular, the fact that 80 percent of left handers have two dextral parents is not easy to explain on environmental grounds.

4.) Children adopted by left-handed parents are not more often sinistral than those adopted by right-handers (e.g. Carter-Saltzman, 1980). Intra-familial learning therefore seems to play little or no part in manual preference (Beaton, 1985, p. 21).

The genetic theory is currently favored over other theories concerning the origin of handedness, but it seems that culture also contributes to the effect (LeDoux, 1984, p. 234).

Cognitive development as related to handedness

Although it has repeatedly been suggested that non-right-handers are at a cognitive disadvantage, large-scale studies have not confirmed these claims (Hardyck and Petrinovich, 1977; Hicks and Kinsbourne, 1978). Yet, indications of differences in the cognitive development of right and non-right-handers persists (Herron, ed., 1980, p. 182).

Studies that compare the performance of left-handers and right-handers on tests of higher mental functions have yielded little in the way of data to support predictions of inferior performance by left-handers; however, the association of left-handedness with deficits persists. (It is important to remember that this deficit is a relative one only). This is most likely the result of the high incidence of left-handedness among the mentally retarded and reading-disabled. This association suggests that some of the left-handedness in these groups selected for deficits is pathological in origin. The same damage that

produces the impairment may also be responsible for the shift to left-handed usage. It does not follow, however, that a similar relationship holds for unselected groups of subjects obtained outside of clinical settings.

Some investigators have suggested that the more bilateral distribution of language function that appears to be characteristic of left-handers may result in superior abilities. The argument has been made that creativity might be enhanced in individuals whose brains permit a great interplay between verbal and nonverbal abilities by virtue of their being housed within the same hemisphere. Occasional studies have reported superior performance by the left-hander, but these studies do not show any more clear a picture than do those pointing to deficits in left-handers (Springer and Deutsch, 1981, pp. 119-120).

Despite the suggestion of deficits in left-handers and justified reprisals, it is evident that any difference in the cognitive abilities of left-and-right handers in general are very small and of little practical importance. As in many such studies, it is clear that individual variation within a group is much greater than the statistical difference between groups. Only on a large scale longitudinal study will finally resolve the question of intellectual abilities in the population at large in any way differ in relation to variations in handedness. It must also be emphasized that it may be necessary to consider several classes of non-right-handers, not a heterogeneous group of 'left-handers' in order to evaluate the relationship between handedness and IQ. However, the issue of statistical differences in cognitive functioning and handedness will

continue to be pursued because of its significance to theories of brain variability and organization (Herron, ed., 1980, p. 291).

Difficulties many of the sinistral population face in their daily lives

Unless you yourself belong to the 'sinistral minority', you probably do not fully realize the extent to which a strong left-hander finds it awkward to function at his best in a right-handed society. Fortunately, the left-hander can buy many items designed for him (Gardner, 1964, p. 83). Also, they may obtain information from such organizations as Lefthanders International, which publishes a left-handers magazine and catalog (Gibson, 1989, p. 171), League of Lefthanders, or a magazine simply called Lefty (Lindsay, 1980, p. 55).

The following is a partial listing of items or situations that may cause problems or place left-handers at a disadvantage:

(Barsley, 1967, pp. 213-217; Gardner, 1964, pp. 83-88; Lindsay, 1980, pp. 51-55; Lord, 1986, p. 461; and Harvey, 1989, p. 4).

Sports and Recreation

- fishing reels
- baseball gloves
- baseball fields go from right
- golf clubs
- bowling balls
- string instruments - must be reversed (violins, guitars)
- saxaphones
- knitting, crocheting, embroidery - directions written for right handers
- archery

Occupational

- dental equipment
- power saws, wrenches, T-square made for right handers
- machinery
- army - seniority and honour on right, weapons on left to be ready for action, saluting
- typewriter - significant keys are on the right
- filling out official forms

Eating and Kitchen

- when eating, left arm is in conflict with the right arm of his neighbor
- wall can openers
- egg beaters
- mixing tools
- vegetable parers
- ice cream scoops
- potato peeler
- iron
- sink position
- handles on oven door
- refrigerator door handle on left
- place settings (glasses) at a table
- pouring lips on frypans
- faucet direction on sinks (and tubs)
- jar tops

Education

- write from left to right
- scissors
- wall pencil sharpeners
- spiral notebooks
- desks
- read from left to right
- rulers
- placing paper correctly to write

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Public

- shaking hands
- revolving doors go to right
- pledging allegiance
- layout of stores, most desirable items to the right
- taking an oath of office
- making religious gestures
- doorknobs
- cameras
- water fountains
- stamps on right of envelopes
- check stubs on left
- matchbooks
- TV and radio dials
- slot machines and voting machines
- phone booths designed to be opened by a right hand, phone on left
- ignition switches, radio, gearshift, accelerator, brake for right (cars)

Personal

- winding wrist watch, clocks
- rings usually on left hand
- lapel buttonhole on a man's jacket is always on the left
- women favor left side for lapel
- small change pocket of a man's jacket is inside the right pocket
- diaper pins
- buttons and buttonholes on clothing

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A Summary of the Relationship Between the Various Research Findings and Handedness

1.) The development of human languages has built into them a veer to the right:

'right':	'left':
legality, correct behavior, high moral principles, firmness, masculinity, 'rights of man', 'in his right mind', 'right' and 'left' in politics, theology 'At the right hand of God'	weakness, cowardice, diffuseness of purpose, evil, femininity, sinister, gauche, gawky, deceitful, 'left-handed compliment', insincere, awkward

2.) Taboo for individuals in many countries to use their left hands, especially for writing and eating, though it is becoming more acceptable.

3.) In the past, parents were told that left-handedness could cause stuttering or similar nervous disorders if a parent tried to change that handedness. This is no longer found to be true, though it could still cause some emotional stress (still being debated).

4.) Left-handedness has been considered abnormal because there are more left-handers than right-handers among clinical populations. It is now believed that brain damage caused a shift away from the pre-determined handedness (which is most often right-handedness) to become 'shifted' left-handers.

5.) A common misconception by many is that all left-handed individuals are right-brained or all right-handed individuals are left-brained.

6.) Left-handers are not at an advantage or disadvantage cognitively. All individuals do not approach life in the same way. Yet all use high-level cognitive modes (either the left hemisphere or the right hemisphere of the brain.)

7. There are degrees of handedness. Not all left-handers are totally left-handed. They may do some tasks or deal with some situations with their right hands.

8. Many researchers think handedness is genetically determined, but is influenced by inherited traits or culture. There are still many questions concerning this issue.

Conclusion

From research gathered, it appears that there are some differences between left-handers and right-handers. These differences will vary from person to person. From a physical and social standpoint, it seems that a left-hander must learn to deal with many everyday items and situations in a 'backwards' manner. Some left-handed individuals may experience more problems than others, but it seems that the majority learn to confront difficulties that may occur in a successful manner.

Cognitively, there appears to be little or no difference between left-handers and right-handers as far as intellectual development is concerned. Much of the intelligence gained by all individuals is an expression of, basically, a person's ability and desire to gain knowledge and exposure to enriched life experiences. Each individual can accomplish goals no matter the hand preference.

All in all, it seems that left-handedness has existed from the beginning of time, and for whatever reason caused the left-handedness, it will continue to be. The sinistral population appears to be on the increase, so perhaps it is becoming more acceptable. Research will surely be continued on this subject in the future, as it raises so many questions.

Annotation

The following is a partial listing of 'famous' people who were (or are) left-handed:

Jimmy Connors (plays tennis left-handed)
Sandy Koufax
Paul McCartney
Alexander the Great
Julius Caesar
Napoleon
King George II
Queen Victoria
King George VI
Prince Charles
James Garfield
Nelson Rockefeller
Albert Einstein
Carl Phillip Emanuel Bach (son of Johann Sebastian Bach)
Bob Dylan
W. C. Fields
Dick Van Dyke
Carol Burnett
Cloris Leachman
Danny Kaye
Peter Fonda
Paul Michael Glaser
Michael Landon
Robert Redford
Judy Garland
Marilyn Monroe
Vida Blue
Ty Cobb
Whitey Ford
Reggie Jackson
Ron Guidry
Stan Musial
Sam Adams — are left-handed, but play
Ben Hogan — golf right-handed to get
Johnny Miller — the power of the left hand
Frankie Albert
Kenny Stabler
Rod Laver
Guillermo Vilas
Sylvester Stallone
Earl Anthony
Bruce Jenner
Dorothy Hamil
Pele
Mark Spitz
Billy the Kid
The Boston Strangler
Jack the Ripper
Lord Nelson (left-handed after an accident)
Harpo Marx
Rex Harrison

Kim Novak
Betty Grable
Olivia de Havilland
Liberace
Benjamin Franklin
Cole Porter
Charlie Chaplin
Michelangelo
Boy Scouts (left-handed handshake)
Babe Ruth
F. Lee Bailey
Rock Hudson
Leonardo da Vinci
Sir Thomas Brown (the first man to suggest in writing the theory of cerebral dominance)
Ringo Starr
Harry Truman
Gerald Ford
George Bush
Caroline Kennedy
Charlemagne
David Letterman
George Burns
Raphael
Picasso

(Lindsay, 1980, pp. 2-22; Barsley, 1967, pp. 209-211; Sagan, 1978, p. 188; Lord, 1986, p. 464; and Harvey, 1989, p. 4).

Bibliography

Barsley, Michael. Left-Handed People. Calif.: Wilshire Book Co., 1967.

Beaton, Alan. Left Side, Right Side: A Review of Laterality Research. New Haven, Conn.: Yale University Press, 1985.

Clark, Barbara. Growing Up Gifted. Columbus, Ohio: Charles E. Merrill Publishing Co., 1983.

Corballis, Michael and Ivan Beale. The Ambivalent Mind. Chicago: Nelson-Hall, 1984.

Fadely, Jack and Virginia Hosler. Understanding the Alpha Child at Home and School. Springfield, Ill.: Charles Thomas, Publisher, 1979.

Gardner, Martin. The Ambidextrous Universe. New York: Basic Books, Inc., 1964.

Gibson, Janice T. 'On the Other Hand'. Parents Magazine, Vol. 64, No. 2, Feb., 1988.

Hardyck, Curtis and Lewis F. Petrinovich. 'Left-Handedness'. Psychological Bulletin, Vol. 84, No. 3, May, 1977.

Harvey, Paul. 'The World is Unfair to 'Lefties'', Kentucky New Era, 25 July 1989, p. 4A, cols. 1-3.

Herron, Jeannine, ed. Perspectives in Neurolinguistics and Psycholinguistics. New York: Academic Press, Inc., 1980.

'Southpaws, How Different Are They?'. Psychology Today. Mar., 1976.

LeDoux, Joseph. 'Handedness'. Academic American Encyclopedia. 1984 ed.

Lindsay, Rae. The Left-Handed Book. New York: Franklin Watts, 1980.

Lord, Thomas. 'A Look at Hand Preference in Homo Sapiens'. The American Biology Teacher, Vol. 48, No. 8, Nov./Dec., 1986.

Patterson, R. F., ed. New Webster's Dictionary. Miami, Fla.: P.S.I. and Associates, Inc., 1989.

Sagan, Carl. The Dragons of Eden. New York: Random House, Inc., 1979.

Springer, Sally and George Deutsch. Left Brain, Right Brain. San Franscisco: W. H. Freeman and Co., 1981.

Vitale, Barbara M. Unicorns are Real: A Right-Brained Approach to Learning. Rolling Hill Estates, Calif: Jalmar Press, 1985.

Williams, Linda. Teaching for the Two-Sided Mind. Englewood Cliffs, N. J.: Prentice Hall, 1983.